



NEVADA DEPARTMENT OF TRANSPORTATION RESEARCH DIVISION

DEVELOPING QUALITY-CONTROLLED DATASETS AND METHODS TO ASSESS THE IMPACT OF RAIN ON SNOW EVENTS ON NEVADA HIGHWAYS

Key · Points

Project Number:
296-22-803

Start Date:
June 27, 2022

Duration:
16 months

Project Cost:
\$99,952.00

Researcher:
Desert Research
Institute

**Principal
Investigator:**
Ben Hatchett

NDOT Champion:
Jim Moore
Brian Matthews

PROBLEM

Major winter floods in Nevada have been a result of mid-winter runoff from rain-on-snow (ROS) events. While there is some information about the meteorological factors that lead to the flooding, the impact of the snowpack on the flood is less understood. The ROS flooding problem presents an opportunity to improve the understanding of (1) ROS runoff potential that could be integrated into transportation infrastructure design and (2) identification of high-risk weather and antecedent snowpack conditions that could provide additional lead time when preparing for high impact events. ROS floods are projected to become more frequent and with larger flood volumes in the future. By identifying roadways at-risk for ROS flood damages and developing a method for using NDOT RWIS and other weather data or information (e.g., National Weather Service forecasts, FEMA reports) to assess flood risk, NDOT can better prepare for and respond to extreme weather events.

OBJECTIVES

The proposed research project will address the following objectives: (1) Identify high-risk winter season flood impact study area(s). (2) Develop/ improve automated data download methods and semi-automated quality control methods for various data sources. Additionally, identify the climate and snowpack elements most predictive of ROS runoff by linking various data sources to stream flow responses. (3) Develop return interval estimates of water flow due to ROS snowmelt runoff suitable for NDOT HEC-HMS modeling. Use extreme value estimates to conduct a risk analysis of current NDOT waterway design standards based on the extreme ROS events and recommend updates to design requirements as needed. (4) Create a website, hosted by the Utah Climate Center, that provides real-time maps that couple 7-day meteorological forecasts with high-risk antecedent snowpack conditions at a 4km resolution. (5) Create a final report that describes research findings and provides instructions on how to use the data and website products created as a result of this research.

METHODOLOGY

This project will be divided into a pre-phase and three additional phases to be completed over a one-year period. The pre-phase will identify mid-winter, snowmelt runoff impacted regions, through a review of the NDOT roadway maintenance records and the snow climatology maps (i.e. Daily 4 km Gridded SWE product from NASA National Snow and Ice Data Center). The first phase will focus on developing/ improving automated data download methods for various data sources. The second phase will focus on extreme

value analysis as applied to engineering design. The process involves collecting historical measurements and fitting probability distributions to the extreme events in order to predict the magnitude of future extreme events. The third phase will focus on predicting ROS events using applied science tools and real-time maps. The findings from these phases will result in a final report, making the quality-controlled data products available for future internal hydrological modeling and general research applications.

IMPLEMENTATION POTENTIAL

This research will create a process that will transform existing available data into a product that may be used in hydrologic evaluations. The literature review will focus on the NDOT objectives of estimating higher level ROS storm events. It will also look to take advantage of 15 years of hourly data from the existing SNOTEL network and provide meaningful analysis of potential future impacts to NDOT infrastructure under increased magnitude and frequency of ROS events.

Contact Information:

Nevada Department of Transportation – Research Annex 14-15
1263 South Stewart Street
Carson City, NV 89712
www.nevadadot.com